

CHAPTER 1—AMOUNT AND DISTRIBUTION OF RESEARCH SPACE

HIGHLIGHTS

- In 1998, the science and engineering fields occupied 286 million net assignable square feet in the Nation's research-performing colleges and universities. Half of this space, 143 million NASF, was devoted to research (table 1-1).
- Fifty-nine percent of the total academic space in the Nation's research-performing institutions was allocated to S&E fields in 1998 (table 1-2).
- The top 100 universities in research and development expenditures accounted for 71 percent of all S&E research space in 1998 (table 1-1), and 80 percent of all R&D dollars in 1996 (the most recent year for which data were available).
- Between 1988 and 1998, the amount of S&E research space increased by 28 percent, from 112 million to 143 million NASF (table 1-3).
- In 1998, 84 percent of all research-performing institutions had S&E research space in the biological sciences outside of medical schools, and 83 percent had S&E research space in the physical sciences. Only 16 percent of the research-performing institutions had S&E research space in the agricultural sciences (table 1-5).
- The amount of research space in engineering and the agricultural sciences increased the most (7 million NASF each) over the last decade (table 1-6).

INTRODUCTION

How much space is available for scientific and engineering research in the Nation's colleges and universities? Has the space increased since 1988, the first year in which NSF conducted the facilities survey? How is the space distributed among different science and engineering fields? This chapter compares the amount of S&E research space in different types of colleges and universities and in different S&E fields and examines changes in the amount of space available for S&E research since 1988.

This chapter is based on responses to Items 1a and 1b of the survey (see Appendix C). Item 1a collects data on space for each of the S&E fields in units of net assignable square feet. NASF is defined as the sum of all areas (in square feet) on all floors assignable to, or available to be assigned to, an occupant for specific use, such as instruction or research. Two categories of S&E space are included:

- ***Instructional and research NASF.*** This includes all space used for academic purposes; it includes space that is used for instruction and space that is used for research.
- ***Research NASF.*** This is space that is used only for research; it does not include space that is used for instruction.

Respondents were asked to consider several issues in determining the amount of space their college or university devotes to S&E research:

- ***Space may be used for more than one purpose or be shared by more than one field.*** Examples include a laboratory that is used for research only part of the time or a building that is shared by two or more fields. For multipurpose or shared space, the survey asks respondents to prorate the space. For instance, if a laboratory is used for research 30 percent of the time, respondents should consider 30 percent of the laboratory's NASF to be research space. If mathematics and computer sciences use the same laboratory, the space reported for each field should reflect the amount prorated by the amount of time that field uses the space.
- ***Some fields require more research space than others.*** More research space in a field does not necessarily indicate that that field has sufficient space for conducting research. For instance, research in the agricultural sciences requires considerably more space than research in mathematics.

- ***Some space reported as under construction may be included in current space estimates.*** Research space under construction during the 1996 or 1997 fiscal years (see Item 4a) may or may not be included in estimates of existing research space if that space was completed and occupied before the fall of 1997.

FINDINGS

AMOUNT OF S&E SPACE

In 1998, the Nation's 660 research-performing academic institutions had a total of 488 million net assignable square feet of academic space in all fields (table 1-1). The doctorate-granting universities accounted for 85 percent of this space (416 million NASF) and the nondoctorate-granting institutions accounted for the remaining 15 percent (72 million NASF). The top 100 institutions in research expenditures had 16 million or 7 percent more NASF than the other 560 research-performing colleges and universities (other doctorate-granting and nondoctorate-granting) combined. In other words, although the top 100 institutions constitute only 15 percent of all research-performing colleges and universities, they account for 52 percent of the space in all academic fields (252 million NASF).

The top 100 universities also devoted more of their academic space to S&E than either the other doctorate-granting institutions or the nondoctorate-granting institutions. Whereas the top 100 universities devoted 70 percent of all academic space (instructional and research)

to S&E, the other doctorate-granting and nondoctorate-granting institutions dedicated 51 and 35 percent, respectively (table 1-2; figure 1-1).

AMOUNT OF S&E SPACE USED FOR RESEARCH

In 1998, 59 percent of the total academic space at the Nation's research-performing institutions was allocated to S&E fields (table 1-2). Half of all space in the S&E fields (143 million NASF) was devoted to S&E research:

- The top 100 universities devoted the largest share of their S&E space to research, 57 percent;
- Other doctorate-granting universities dedicated 41 percent of their S&E space to research; and
- Nondoctorate-granting institutions dedicated 29 percent of their S&E space to research.

The distribution of S&E research space in research-performing colleges and universities is roughly proportional to the distribution of research and development expenditures. In 1996, the most recent year for which data were available, the top 100 universities accounted for 80 percent of all R&D expenditures¹² and 71 percent of the total S&E research space in 1998 (table 1-1).

¹² National Science Foundation/Division of Science Resources Studies, *Academic Research and Development Expenditures: Fiscal Year 1996*, NSF 98-304.

Table 1-1. Amount of instructional and research space by institution type: 1998

| Institution type | Number of institutions | Instructional and research space in all academic fields | Instructional and research space in S&E fields | Research space in S&E fields |
|---------------------------------------|------------------------|---|--|------------------------------|
| NASF in millions | | | | |
| Total..... | 660 | 488 | 286 | 143 |
| Doctorate-granting..... | 378 | 416 | 261 | 136 |
| Top 100 in research expenditures..... | 100 | 252 | 177 | 101 |
| Other..... | 278 | 164 | 84 | 35 |
| Nondoctorate-granting..... | 282 | 72 | 25 | 7 |

KEY: S&E = science and engineering.
NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

**Table 1-2. Science and engineering research space utilization
by institution type: 1998**

| Institution type | S&E space | Research space | |
|---------------------------------------|---|------------------------------------|---|
| | As a percentage of total academic space | As a percentage of total S&E space | As a percentage of total academic space |
| Total..... | 59 | 50 | 29 |
| Doctorate-granting: | | | |
| Top 100 in research expenditures..... | 70 | 57 | 40 |
| Other..... | 51 | 41 | 21 |
| Nondoctorate-granting..... | 35 | 29 | 10 |

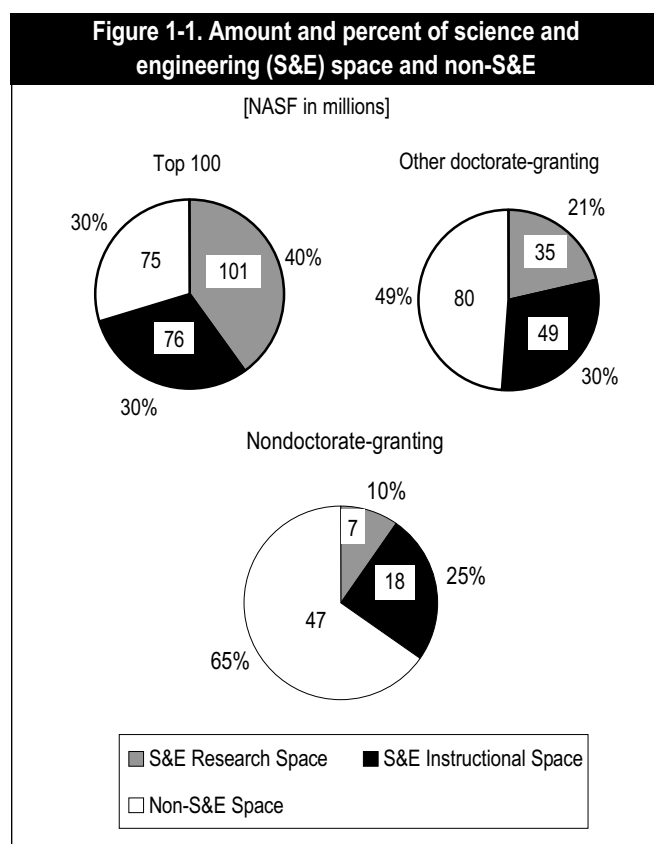
KEY: S&E = science and engineering.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

CHANGES IN THE AMOUNT OF S&E RESEARCH SPACE

Over the last decade, the amount of S&E research space has increased steadily, from 112 million NASF in 1988 to 143 million NASF in 1998 (table 1-3). This change represents a 28-percent increase.

Most of the increase in the amount of research space resulted from steady growth at the top 100 institutions. S&E research space at these institutions increased by 25 percent or 20 million NASF—from 81 million NASF in 1988 to 101 million in 1998. The increase in the amount of research space at other doctorate-granting and nondoctorate-granting institutions was smaller—8 million NASF and 2 million NASF, respectively. It is important to note, however, that although the increases these institutions experienced are smaller in absolute terms than that of the top 100 institutions, the relative proportional increase is larger, a 30-percent increase for the other doctorate-granting institutions and a 40-percent increase for the nondoctorate-granting institutions.



KEY: NASF = net assignable square feet.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 1-3. Trends in the amount of science and engineering research space by institution type: 1988–98

| Institution type | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 |
|---------------------------------------|------|------|------|------|------|------|
| NASF in millions | | | | | | |
| Total..... | 112 | 116 | 122 | 127 | 136 | 143 |
| Doctorate-granting..... | 107 | 111 | 117 | 122 | 131 | 136 |
| Top 100 in research expenditures..... | 81 | 82 | 88 | 91 | 98 | 101 |
| Other..... | 27 | 30 | 30 | 31 | 32 | 35 |
| Nondoctorate-granting..... | 5 | 5 | 5 | 5 | 6 | 7 |

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

AMOUNT OF LEASED S&E SPACE

In 1998, research-performing colleges and universities leased 6.1 million NASF, or 4 percent of their total S&E research space (table 1-4). This represents a 61-percent increase in leased S&E research space since 1988 when 3.8 million NASF of research space was leased. The top 100 institutions leased the most space: 4.8 million NASF (5 percent of their total S&E research space). Although not addressed in the survey, there are a number of possible explanations for why institutions lease rather than build or purchase S&E research space: an unanticipated need for space that cannot be met with existing facilities; a short-term need that does not warrant the construction of new space or the conversion of existing space; research projects that the institution considers low priority; and insufficient funds to construct new S&E research space.

DISTRIBUTION OF RESEARCH SPACE ACROSS S&E FIELDS

In 1998, a majority of institutions had S&E research space in seven of the S&E fields. These fields include:

- The biological sciences outside of medical schools (84 percent);
- The physical sciences (83 percent);
- Psychology (70 percent);
- The social sciences (63 percent);
- Mathematics (60 percent);
- The computer sciences (56 percent); and
- The earth, atmospheric, and ocean sciences (53 percent) (table 1-5).

While only 44 percent of all research-performing institutions reported S&E research space in engineering and only 16 percent reported research space in the agricultural sciences, the total amount of research space in these two fields—23 million NASF and 25 million NASF, respectively (see table 1-6)—is greater than that in any other field.

| Table 1-4. Trends in the amount of leased science and engineering research space by institution type: 1988–98 | | | | | | |
|---|------------------|------|------|------|------|------|
| Institution type | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 |
| | NASF in millions | | | | | |
| Total..... | 3.8 | 3.6 | 4.8 | 4.4 | 5.5 | 6.1 |
| Doctorate-granting..... | 3.8 | 3.5 | 4.7 | 4.3 | 5.4 | 6.0 |
| Top 100 in research expenditures..... | 2.8 | 2.6 | 3.5 | 3.7 | 4.5 | 4.8 |
| Other..... | 0.9 | 0.9 | 1.2 | 0.6 | 0.9 | 1.2 |
| Nondoctorate-granting*.... | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |

*Nondoctorate-granting values for 1988–96 have been revised from the 1996 report.

KEY: NASF = net assignable square feet.
NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

About one fifth of all research-performing institutions reported S&E research space in medical schools, both in the biological sciences (19 percent) and the medical sciences (19 percent). Among the top 100 institutions, 62 percent reported research space in the medical sciences in medical schools, and 53 percent reported research space in the biological sciences in medical schools, whereas among the other doctorate-granting institutions, 23 percent reported research space in the medical sciences in medical schools and 26 percent reported research space in the biological sciences in medical schools. By contrast, nondoctorate-granting institutions had virtually no research space in medical schools.¹³

¹³ One nondoctorate-granting institution reported space in the biological sciences in a medical school. This institution conducts research and grants masters’ degrees through an arrangement with another university that has a medical school.

Table 1-5. Percentage of institutions with science and engineering research space by institution type and field: 1998

| Field | Total | Institution type | | |
|------------------------------|------------|----------------------------------|-------|-----------------------|
| | | Doctorate-granting | | Nondoctorate-granting |
| | | Top 100 in research expenditures | Other | |
| Number of institutions..... | 660 | 100 | 278 | 282 |
| | Percentage | | | |
| Biological sciences— | | | | |
| inside medical schools..... | 19 | 53 | 26 | -- |
| outside medical schools..... | 84 | 94 | 78 | 87 |
| Physical sciences..... | 83 | 89 | 78 | 85 |
| Psychology..... | 70 | 86 | 59 | 76 |
| Social sciences..... | 63 | 89 | 57 | 59 |
| Mathematics..... | 60 | 82 | 54 | 58 |
| Computer sciences..... | 56 | 76 | 51 | 53 |
| Earth, atmospheric, and | | | | |
| ocean sciences..... | 53 | 85 | 51 | 43 |
| Engineering..... | 44 | 86 | 47 | 26 |
| Agricultural sciences..... | 16 | 40 | 10 | 14 |
| Medical sciences— | | | | |
| inside medical schools..... | 19 | 62 | 23 | -- |
| outside medical schools..... | 40 | 75 | 41 | 26 |
| Other sciences..... | 23 | 36 | 21 | 19 |

KEY: -- = no institutions had space in this field.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

S&E RESEARCH SPACE BY FIELD

Increases in research space in any single field tended to be gradual over the decade from 1988–98. Research space in engineering and the agricultural sciences grew the most (7 million NASF each), followed by the medical sciences in medical schools and the biological sciences in medical schools (4 million NASF each) (table 1-6).

The distribution of research space across the S&E fields approximated the distribution of R&D expenditures across the same fields. The life sciences occupied 56 per-

cent of the S&E research space in 1998 and accounted for 55 percent of 1996 R&D expenditures in 1996.¹⁴ Similarly, psychology and other sciences each occupied 2 percent of the S&E research space, and each accounted for 2 percent of R&D expenditures (table 1-7).

¹⁴ The 1998 expenditure data were not available at the time this report was written. The most recent expenditure data, 1996, were therefore used. National Science Foundation/Division of Science Resources Studies, *Academic Research and Development Expenditures: Fiscal Year, 1996*, NSF 98-304.

Table 1-6. Trends in the amount of science and engineering research space by field: 1988–98

| Field | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 |
|------------------------------|------|------|------|------|------|------|
| NASF in millions | | | | | | |
| Total..... | 112 | 116 | 122 | 127 | 136 | 143 |
| Biological sciences— | | | | | | |
| inside medical schools..... | 8 | 9 | 11 | 11 | 11 | 12 |
| outside medical schools..... | 16 | 18 | 17 | 17 | 19 | 19 |
| Physical sciences..... | 16 | 16 | 16 | 17 | 18 | 18 |
| Psychology..... | 3 | 3 | 3 | 3 | 3 | 3 |
| Social sciences..... | 3 | 3 | 3 | 3 | 4 | 5 |
| Mathematics..... | 1 | 1 | 1 | 1 | 1 | 1 |
| Computer sciences..... | 1 | 1 | 2 | 2 | 2 | 2 |
| Earth, atmospheric, and | | | | | | |
| ocean sciences..... | 6 | 6 | 7 | 7 | 7 | 8 |
| Engineering..... | 16 | 17 | 18 | 21 | 22 | 23 |
| Agricultural sciences..... | 18 | 21 | 20 | 20 | 22 | 25 |
| Medical sciences— | | | | | | |
| inside medical schools..... | 14 | 15 | 16 | 17 | 18 | 18 |
| outside medical schools..... | 5 | 5 | 6 | 6 | 7 | 7 |
| Other sciences..... | 4 | 2 | 2 | 2 | 2 | 3 |

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities.

Table 1-7. Comparison of the distribution of 1996 research and development (R&D) expenditures and 1998 science and engineering (S&E) research space by field

| Field | 1996 R&D expenditures | | 1998 S&E research space | |
|---|---------------------------|--------------------------|---------------------------|-----------------------|
| | Distribution [Percent] | Dollars [In millions] | Distribution [Percent] | NASF [In millions] |
| Total..... | 100 | 22,995 | 100 | 143 |
| Engineering..... | 16 | 3,675 | 16 | 23 |
| Physical sciences..... | 10 | 2,260 | 13 | 18 |
| Earth, atmospheric, and ocean sciences..... | 6 | 1,478 | 5 | 8 |
| Mathematics..... | 1 | 289 | 1 | 1 |
| Computer science..... | 3 | 702 | 1 | 2 |
| Life sciences..... | 55 | 12,697 | 56 | 81 |
| Psychology..... | 2 | 372 | 2 | 3 |
| Social sciences..... | 5 | 1,104 | 3 | 5 |
| Other sciences..... | 2 | 419 | 2 | 3 |

KEY: NASF = net assignable square feet.

NOTE: Components may not add to totals due to rounding. Life sciences includes the biological sciences and the medical sciences, inside and outside of medical schools, and the agricultural sciences.

SOURCE: National Science Foundation/Division of Science Resources Studies, 1998 Survey of Scientific and Engineering Research Facilities at Colleges and Universities; and *Academic Research and Development Expenditures: Fiscal Year 1996*.